Reg. No._____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION JULY 2017

Course code**: CH 204**

Course Name**: CHEMICAL ENGINEERING THERMODYNAMICS (CH)**

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any TWO questions.

1. a) What are the limitations of first law of Thermodynamics? (2)
   b) State Second law of Thermodynamics. (3)
   c) A block of copper at a temperature of 825 K and weighing 5 kg is dropped into 50 kg water at 300K. If there are no heat losses, what is the change in entropy of (i) Copper (ii) Water and (iii) Copper and water both considered together? C_p of copper is 0.4 kJ/kgK and that of water is 4.2 kJ/kg K. (10)
2. a) Show that the maximum fluid velocity attainable for flow through a pipe of uniform cross section is equal to the sonic velocity. (5)
   b) Prove that a throttling expansion is an isenthalpic operation. (3)
   c) Determine the molar volume of gaseous methane at 300 K and 600 bar by the following methods:
      i) Using the ideal gas equation
      ii) Using vanderwaals equation given that a = 0.2285 Nm^4/mol^2 and b = 4.27 x 10^{-5} m^3/mol. (7)
3. a) Derive Maxwell's equations from the fundamental differential equations. (5)
   b) Prove that : $ds = \frac{Cv}{T} dT - \frac{\partial V/\partial T}{\partial V/\partial P} dV$ (5)
   c) What is the standard state for fugacity for real gases and how do you Estimate the Fugacity of a liquid at temperature T. (5)

PART B

Answer any TWO questions.

4. a) Define chemical potential. What are the effects of pressure and temperature on Chemical Potential? (5)
   b) How you determine the fugacity coefficient of a component in a solution? (5)
   c) What is Lewis – Randall rule? (5)
5. a) Write the Gibbs- Duhem equation and its various forms. What are the major fields of application of the Gibbs- Duhem equation? (5)

b) The activity coefficient of thallium in amalgam at 293 K are given below.

x_2	0	0.00326	0.01675	0.04856	0.0986	0.168	0.2701	0.424
γ_2	1	1.042	1.231	1.776	2.811	4.321	6.196	7.707

Determine the activity coefficient of mercury (component 1) at various compositions. (10)

6. a) What are Azeotropes? Distinguish the minimum and maximum boiling Azeotropes. What is the effect of pressure on the azeotropic composition? (10)

   b) What is the Zero area method for testing the consistency of VLE data? (5)

PART C

Answer any TWO questions.

7. a) How do you estimate the bubble point temperature and pressure of a multi component system? (5)

   b) Differentiate Binary and Ternary liquid equilibrium diagram. (10)

   c) What is the principle of steam distillation? Why we prefer steam distillation for separation of a component from a mixture? (5)

8. a) What is phase rule as applicable to reacting systems? (5)

   b) What is the effect of temperature on equilibrium constants? (5)

   c) How do you predict the feasibility of a reaction from the value of the standard free energy change? (5)

   d) How the equilibrium constants for a liquid- phase reactions is evaluated? (5)

9. a) What are the criterions on Chemical Reaction Equilibria? (5)

   b) Define Equilibrium constant K of a Chemical Reaction. How is it related to K_f and K_p? (5)

   c) What are the factors affecting equilibrium conversions? (10)

****